Detection of Martian Nightglow NO bands in UV and implications or Atmospheric Transport

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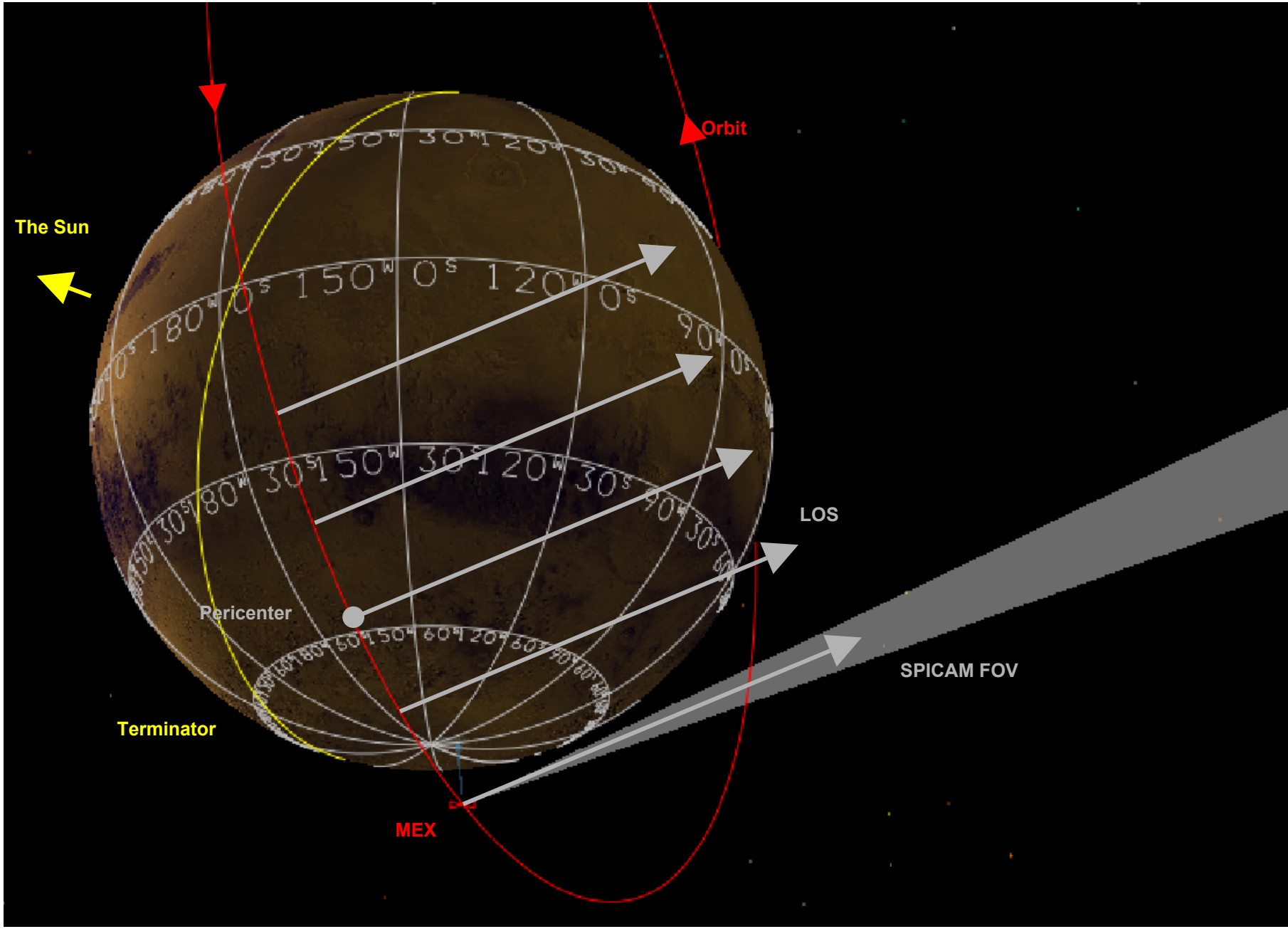
First observation of martian nightglow

- Recombination of O and N atoms
- O+N ----- > NO + UV photon
- Paper published (Science, 28 January 2005,vol.307,p.566)
- season: winter at South pole, continuous night


Orbit
The Sun
LOS
Pericenter
SPICAM FOV
Terminator
MEX

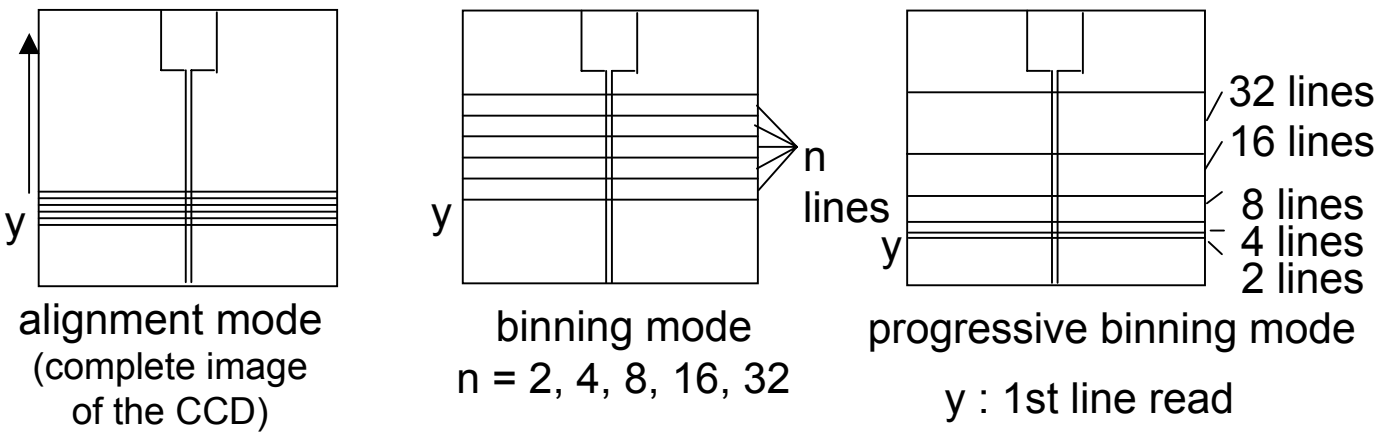
SPICAM Instrument (2/3)

➢ **Different operating modes for each channel**

UV channel = CCD (290*408 pixels - 110-320 nm) ± slit

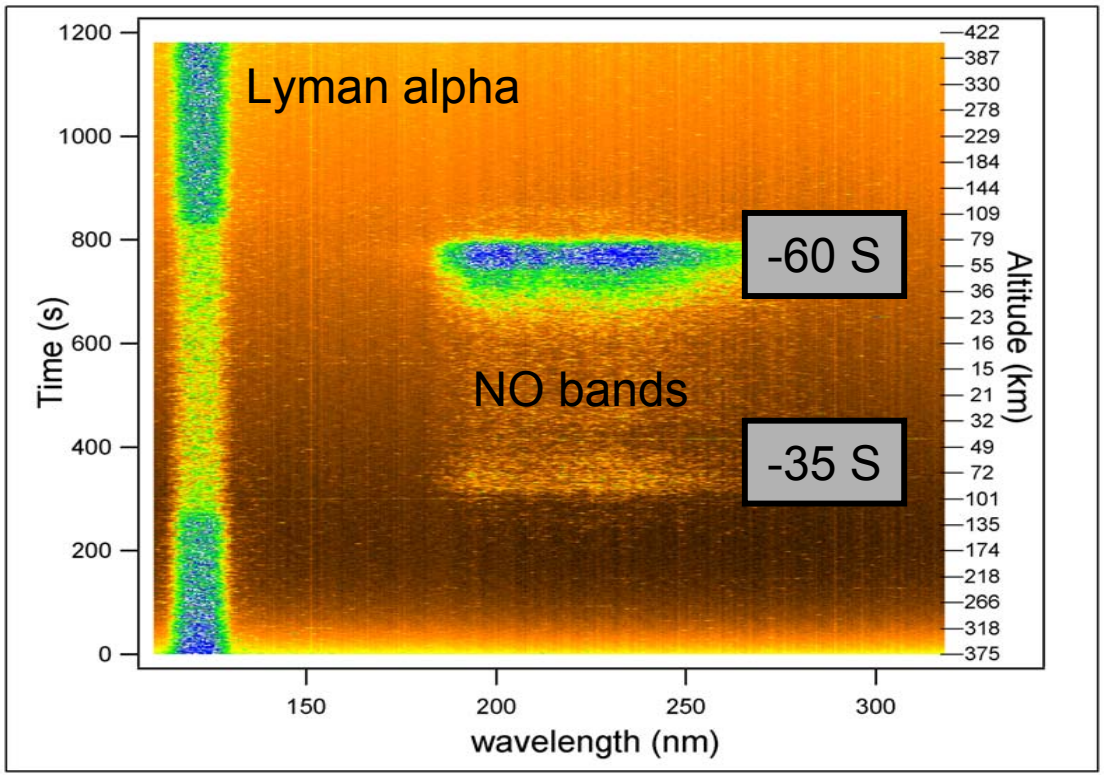
one measurement = 5 spectral bands of 408 pixels

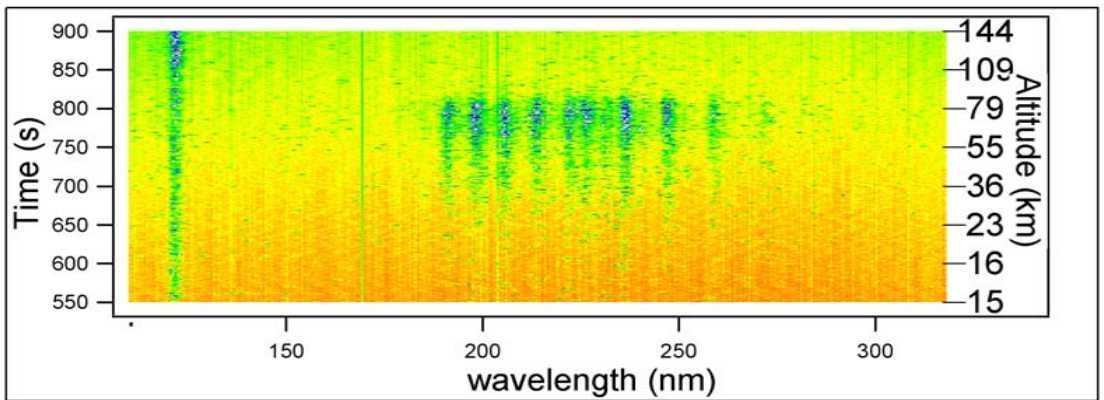
1 spectral band = 1 or n rows (binning)



operating parameters : high voltage, time exposure, binning, slit, acquisition period, duration of obs…enormous dynamic range,from a single photon to the sun

SPICAM Nightglow Discovery

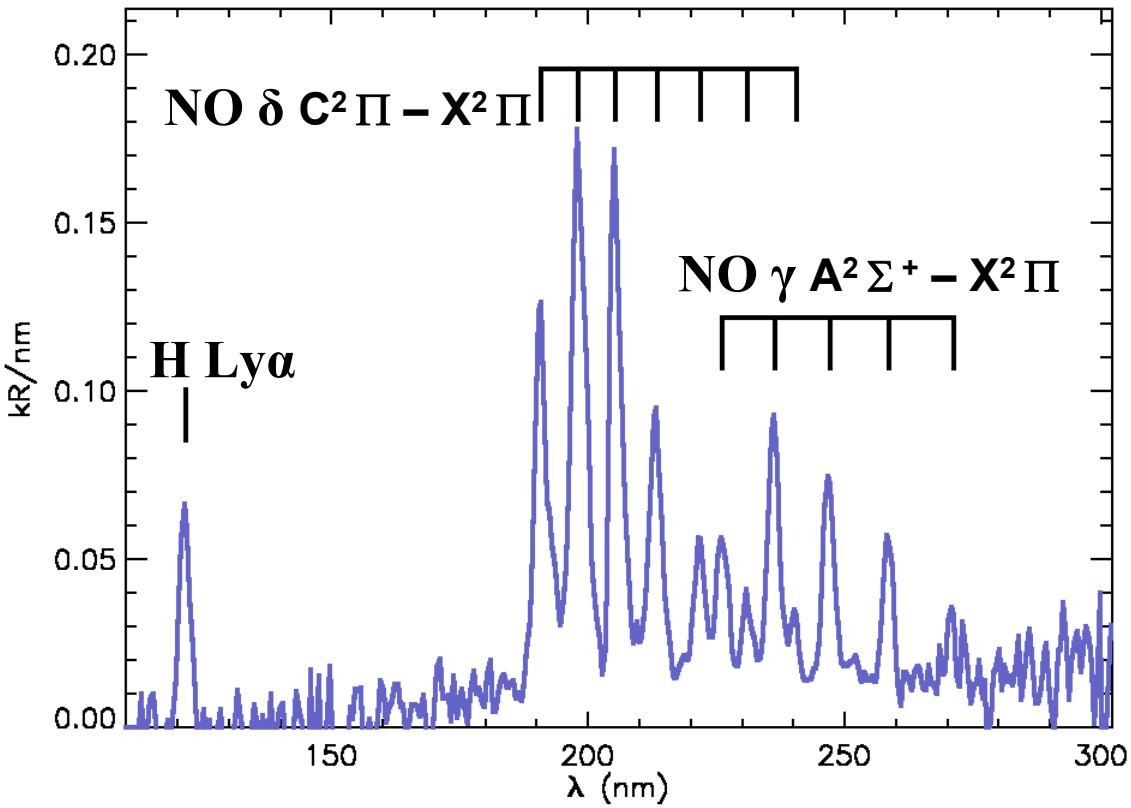




- NO gamma and delta bands discovered in limb scan observations on 16 Aug 2004, L_s=74° (southern winter).
- Martian nightglow spectrum along the grazing limb, uncorrected from dark current and radiometric sensitivity. Top: low spectral resolution. Bottom: high spectral resolution.
- This Martian emission is reminiscent of the UV NO nightglow discovered on Venus by the NASA Pioneer Venus Orbiter in 1979.

H Lyα and NO Nightglow

Martian nightglow obtained by averaging 10 continuous individual spectra obtained in 10 sec. Besides Lyα at 121.6 nm, all observed lines coincide precisely with the main NO gamma and delta vibrational state transitions responsible for the emission of the Venus NO nightglow.



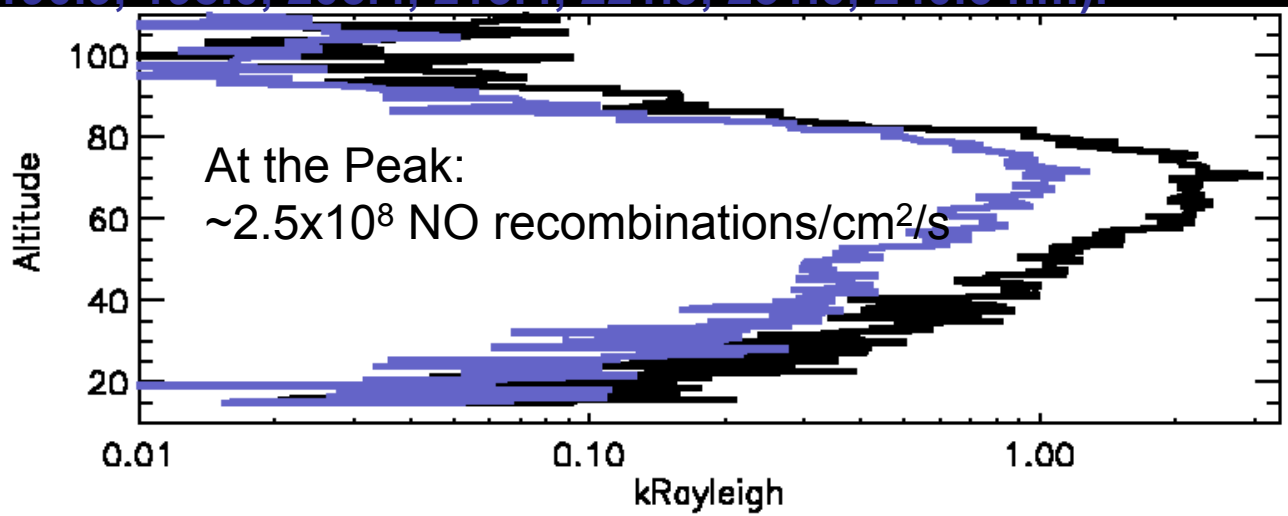
- N and O are created by EUV photodissociation of CO_2, O_2, and N_2; NO is then formed by radiative recombination.
- The observed NO emission is brightest in the winter south polar night, and can be explained by downward transport in this region.
- As such, it opens a new way to study the general circulation mechanisms by remote sensing of the upper atmosphere from Mars orbiters.

NO Nightglow Height Profile

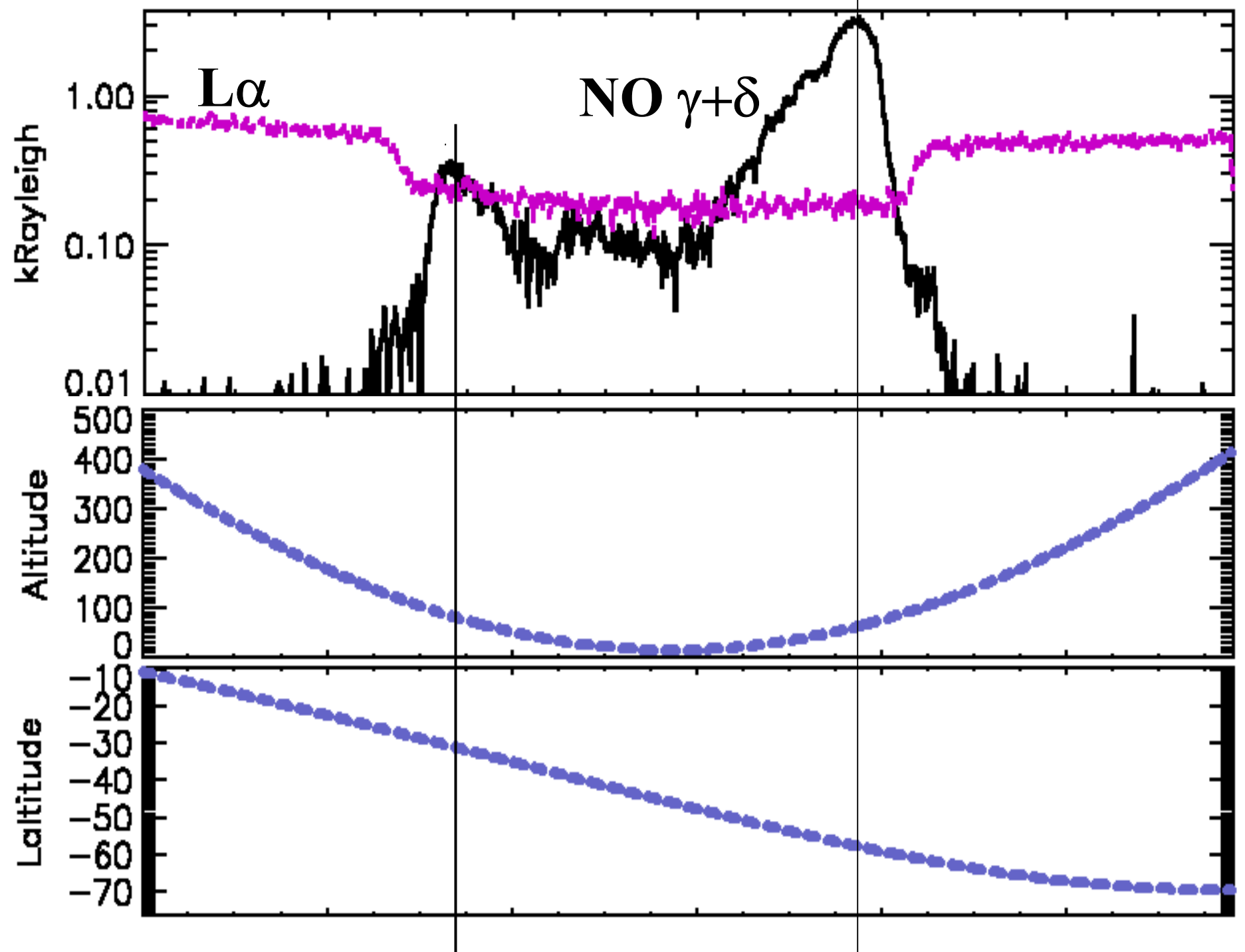
Altitude profile of the limb emission of NO g (blue curve) and (dark curve) system during Orbit 734.

The blue curve is the sum of the bands of the γ system (at 226.2, 236.5, 247.1, 258.7 and 271.3 nm).

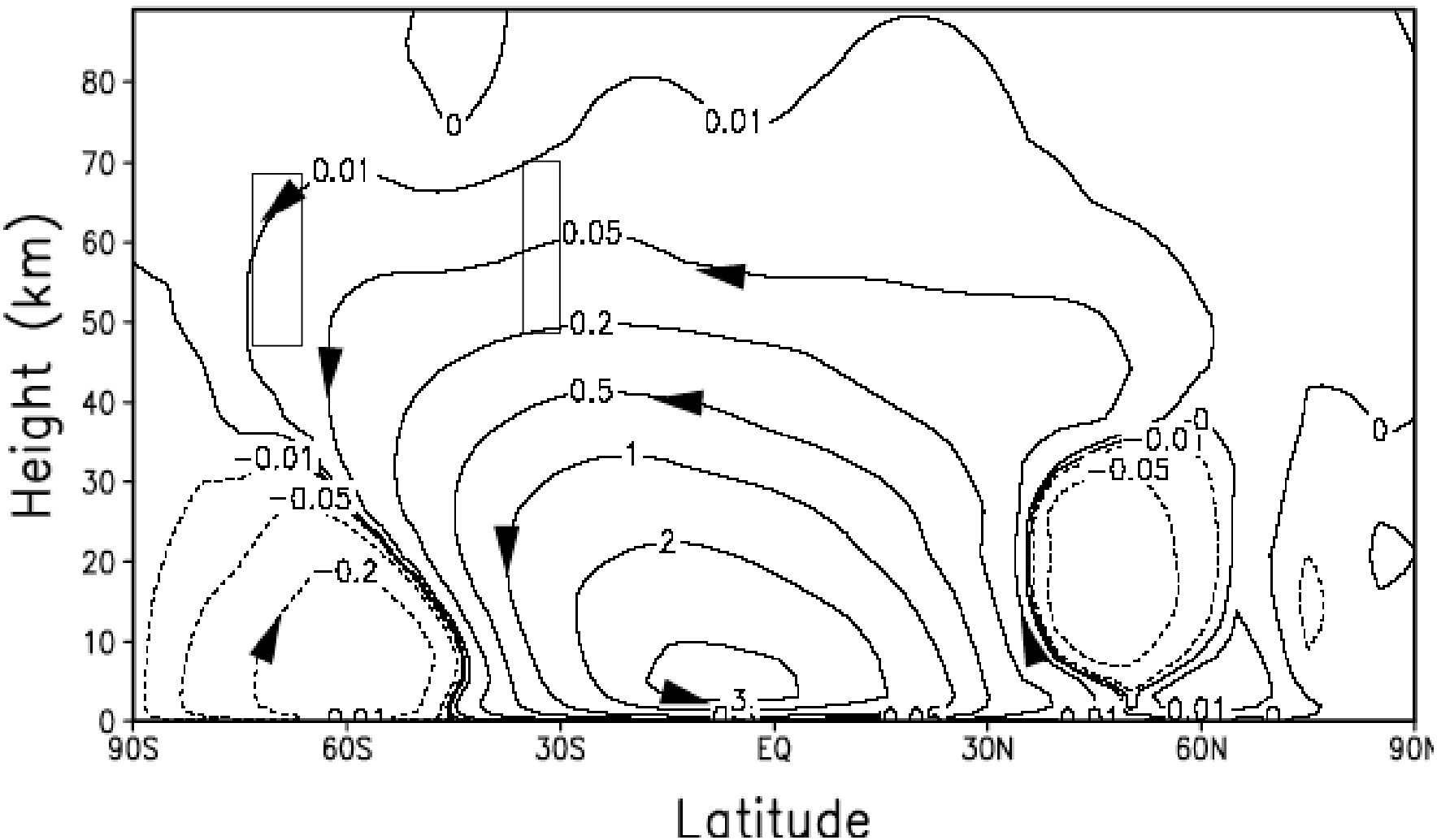
The dark curve is the sum of the bands of the δ system (at 190.9, 198.0, 205.4, 213.4, 221.9, 231.0, 240.6 nm).



Slant Intensity


Lα
NO γ+δ
kRayleigh
1.00
0.10
0.01
Altitude
500
400
300
200
100
0
Laltitude
−10
−20
−30
−40
−50
−60
−70

GCM prediction of meridional mass stream function: average output for season Ls=90-120° (Forget et al., 1999)



Conclusion: Mars NO emission opens a new way to constrain GCM models in a poorly documented region